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GLOSSARY OF TERMS RELATING TO ALUMINIUM AND ALUMINIUM ALLOYS

PART III GEOMETRICAL PROPERTIES AND TOLERANCE, STRUCTURAL AND SURFACE DEFECTS

(First Reprint FEBRUARY 1990)

UDC 669.71-4:531.7:001.4

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4 *December* 1979

Indian Standard

GLOSSARY OF TERMS RELATING TO ALUMINIUM AND ALUMINIUM ALLOYS

PART III GEOMETRICAL PROPERTIES AND TOLERANCE, STRUCTURAL AND SURFACE DEFECTS

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GLOSSARY OF TERMS RELATING TO ALUMINIUM AND ALUMINIUM ALLOYS

PART III GEOMETRICAL PROPERTIES AND TOLERANCE, STRUCTURAL AND SURFACE DEFECTS

0. FOREWORD

0.1 This Indian Standard (Part III) was adopted by the Indian Standards Institution on 23 July 1979, after the draft finalized by the Light Metals and Their Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard (Part III) has been prepared to making the glossary of terms for application in the aluminium industry more comprehensive by including the terms connected with special types of wrought metals, plant and operations, thermal treatment, control and testing, finishing, geometrical properties and tolerance, structural and surface defects, etc. It is hoped that this comprehensive standard on glossary of terms for aluminium and its alloys will help in estabilishing a generally recognized usage for various terms encountered in the aluminium industry and eliminate any confusion which may sometimes arise due to individual interpretation of terms used in the industry.

0.3 This standard is being issued in three parts covering different subjects in a logical sequence. This part dealing with geometrical properties and tolerance, structural and surface defects forms Part III of the series. The other parts in the series are given below:

Part I Unwrought and wrought metals (main and special types)
Part II Plant and operations, thermal treatment, control and testing, finishing

0.4 In the preparation of this standard assistance has been derived from the following:

BS 3660 : 1963 Glossary of terms for aluminium and aluminium alloys. British Standards Institution.

Nomenclature for aluminium mill products. The Aluminium Association of USA.

1. SCOPE

1.1 This standard (Part III) defines commonly used terms in the aluminium industry relating to geometrical properties and tolerance, structural and surface defects and also some general terms not covered in other two parts of the Glossary.

2. TERMS AND DEFINITIONS

2.1 Geometrical Properties and Tolerance

2.1.1 *Tolerance* — An allowable amount of deviation from a specified characteristic.

2.1.2 *Length* — That dimension which lies in the direction of final working.

2.1.3 *Width* — The major dimension which lies transverse to the direction of final working.

2.1.4 *Straightness* — The extent to which the axis or the edge of a product approaches a straight line.

2.1.5 *Lateral Curvature* (*Edge Curvature*) — The lateral departure, in the form of an arc, of an edge from straightness.

2.1.6 *Bow* — Deviation from a straight line of a length of a product following an arc.

2.1.7 *Lateral Bow* — Deviation of a longitudinal edge from straightness (sometimes called camber).

2.1.8 *Longitudinal Bow* — A longitudinal curvature along the length in the plane of a sheet.

2.1.9 *Transverse Bow* — Curvature across the width of sheet or foil.

2.1.10 *Buckle* — A distortion of the surface of sheet such as a bulge or a wave usually transverse to the direction of rolling.

2.1.11 *Flatness* — The extent to which the surface of a product approaches a true plane.

2.1.12 *Concavity* — An inward curvature across the width of a surface of a rolled or extruded product.

2.1.13 *Convexity* — An outward curvature across the width of a surface of a rolled or extruded product.

2.1.14 *Angle* — The relative orientation of two adjacent faces of a section generally measured over the full length of both.

2.1.15 *Angularity* — Conformity to or deviation from, specified angular dimensions in the cross section of a shape or bar.

2.1.16 *Twist* — Torsional deviation of the transverse axis along the length of a product.

2.1.17 *Corner Radius* — The radius of an arc to which adjacent sides of a product are tangential.

2.1.18 *Ovality* — The departure of the cross section of a round tube, bar or wire, from a true circle.

2.1.19 *Concentricity* — Uniformity of wall thickness throughout the cross section of a tube. The tolerance on concentricity is established by the wall thickness tolerance.

2.1.20 *Mean Wall Thickness* — The sum of the wall thickness of tube measured at the ends of any two diameters at right angles, and divided by four.

2.1.21 *Mean Diameter* — The average of two measurements of the diameter at right angles to each other.

2.1.22 *Eccentricity* — Deviation from a common centre as, for example, the inner and outer walls of a round tube. The difference between the mean wall thickness and minimum or maximum wall thickness at any one cross section. The permissible degree of eccentricity can be expressed by a plus and minus wall thickness tolerance.

2.1.23 *Sliding Fit* — The ability of two pieces of metal, one having internal and the other external bearing surfaces of complementary shape, to fit and move easily one within the other.

2.1.23.1 *Snap fit* — To fit one metal piece with another by applying minor pressure.

2.1.24 *Splice* — The end joint uniting two webs.

2.1.25 *Squareness* — Characteristic of having adjacent sides or planes meeting at 90 degrees.

2.1.26 *Web* — A connecting element between ribs, flanges or bosses on shapes and forgings.

2.1.27 *Center* — The difference in thickness between middle and edges of a sheet.

2.1.28 *Fillet* — A concave junction between two surfaces.

2.1.29 *Rib* — An elongated projection on a shape or forging to provide stiffening.

2.2 Structural and Surface Defects

2.2.1 *Non-heat Treatable Material* — Pure metal or that type of alloy which does not respond to solution treatment or precipitation treatment and which therefore requires cold working for the improvement of its mechanical properties.

2.2.2 *Work Hardening* — Effecting an increase in tensile strength by cold deformation.

2.2.3 *Heat-Treatable Alloy* — A type of alloy which will respond to solution treatment or precipitation treatment or both, thus permitting enhanced mechanical properties to be secured.

2.2.4 *Mass Effect* — The effect of the size and shape of an article on the rate of heat transfer during quenching resulting in variations in mechanical properties from the outside to the centre.

2.2.5 *Free Cutting Alloy* — An alloy which by virtue of its chemical composition and condition, has constituents in a spheroidal form distributed throughout the metal which act as chip breakers.

2.2.6 *Natural Oxide Film* — The self-healing film or skin of aluminium oxide which forms naturally on aluminium and which is relatively impervious to atmospheric attack.

2.2.7 *Cold Shut*

a) A linear discontinuity in a cast surface caused when meeting streams of molten metal fail to merge prior to solidification:

b) A forging defect developed by metal flowing into a section from two directions, resulting in a discontinuity at the junction.

2.2.8 *Roll Mark* — A defect on plate, sheet, strip or flattened wire, repeated at regular intervals and caused by an imperfection in the roll surface.

2.2.9 *Pinch Marks* — Pressed-in folds generally running parallel to the direction of rolling.

2.2.10 *Pack Marks* — Small superficial marks associated with differential metal flow in pack rolling.

2.2.11 *Block Marks* — Short longitudinal scratches introduced during rewinding of sheet, strip or foil, resulting from relative movement between adjacent wraps of the coil.

2.2.12 *Reeling Marks* — Superficial spiral markings present on round extruded or drawn products which have been straightened by reeling.

2.2.13 *Stretcher Grip Marks* — Transverse indentation at the ends of a product impressed by the grips of the stretching machine.

2.2.14 *Conveyor Marks* — Scratches and pits occurring on one side of a sheet as a result of contact with cables or other means of conveyance.

2.2.15 *Traffic Marks* (*Transit Abrasions*) — Small black surface spots caused by the attrition of adjacent surfaces during transit.

2.2.16 *Drawn-in-Scratch* — A scratch occurring during the fabricating process and subsequently drawn over making it relatively smooth to touch.

2.2.17 *Herring Bone Streak* — Superficial markings taking the form of alternate light and dark bands forming a V or W pattern across the width of strip-mill rolled material.

2.2.18 *Friction Scratches* — Short longitudinal scratches introduced during coiling or reeling of sheet, strip or foil by relative movement between adjacent wraps of the coil.

2.2.19 *Broken Edge* — Edge containing cracks, splits or tears.

2.2.20 *Broken Surface* — A surface having innumerable minute cracks running normal to the direction of working.

2.2.21 *Broken Matt Finish* — An uneven finish on the matting surfaces of pack rolled foil.

2.2.22 *Surface Bloom* — Surface discoloration which may develop on aluminium during exposure to moist atmospheres or during thermal treatment.

2.2.23 *Telescoping* — Transverse slipping of successive layers of a coil of sheet or foil so that the ends of a coil are conical rather than flat.

2.2.24 *Whip Mark* — Markings on a sheet surface generally running normal to the direction of rolling, resulting from a whipping of the sheet as it enters the rolling mill.

2.2.25 *Oxide Discoloration* — Discoloration of the material surface due to oxidation during thermal treatment.

2.2.26 *Diffusion Staining or Streaks* — Patchy discoloration occurring during the thermal treatment of clad material and resulting from the complete penetration of the cladding by alloying constituents from the core and their reaction with air or water.

2.2.27 *Caustic Stain* — A superficial surface blemish caused by the etching action of caustic.

2.2.28 *Oil Staining* — Staining associated with the partial decomposition of residual lubricant during thermal treatment.

2.2.29 *Water Staining* — Superficial surface oxidation due to the reaction of water films held between closely adjacent metal surfaces such as between wraps of a coil or sheet in a stock. The appearance varies from iridescent in mild cases to white, grey or black in more severe instances.

2.2.30 *Heat Treat Stain* — A discoloration due to oxidation of the metal surface during thermal treatment.

2.2.31 *Lüder Lines* — Strain markings in the form of stepped criss crossed lines.

2.2.32 *Stretcher Strain Markings* — Permanent surface distortion in the form of flamboyant patterns or Lüders lines which appear when materials are stretched. The onset of these markings varies according to the type of the material and the degree of stretching.

2.2.33 *Ripple* — A surface effect in the form of a very slight repeated transverse wave or shadow mark, sometimes encountered with rolled or drawn products.

2.2.34 *Surface Texture* — The quality of a surface according to its degree of roughness as assessed by using a profilometer.

2.2.35 *Chatter* — Regularly spaced superficial transverse markings produced by vibration between the metal and the tools during fabrication, resulting in non-uniform surface reflection and brightness.

2.2.36 *Pick-Up* — An irregular surface roughness caused by intermittent adhesion between the forming tools and the metal.

2.2.37 *Roll Coating Pick-Up* — A surface belmish on rolled material resulting from aluminium oxide transferring from the roll to the sheet surface giving a speckled appearance.

2.2.38 *Orange Peel Effect* — Surface roughening resulting from the deformation under tension of coarse-grained material.

2.2.39 *Pit* — A sharp depression in the surface.

2.2.40 *Speed Cracking* (*Cross Hatching Feathering*) — Transverse surface cracks produced by excessive extrusion speed and/or extrusion emergence temperature.

2.2.41 *Abrasion* (*Scratches*) (*Scuff Marks*) — Surface damage caused by attrition.

2.2.42 *Gouge* — Mechanical damage taking the form of an isolated deep groove.

2.2.43 *Nick* — A surface or edge discontinuity in the form of a slight cut, indentation or notch.

2.2.44 *Score* — A deep scratch.

2.2.45 *Die Lines* — Continuous longitudinal lines formed on extruded or drawn products by minor irregularities on the bearing surfaces of the die.

2.2.46 *Die Scores* — Relatively deep continuous longitudinal lines on extruded or drawn products caused by the build up of aluminium on the bearing surface of the die.

2.2.47 *Lap* — An open ended surface discontinuity formed as a result of metal folding over during mechanical working.

2.2.48 *Fold* — A deep lap.

2.2.49 *Crease* — A shallow lap.

2.2.50 *Chop* — A lap formed at the base of a near vertical face of a die forging by the downward movement of the top die.

2.2.51 *Stop Mark* — A transverse peripheral ridge on a product arising from a stoppage during rolling, extrusion or drawing.

2.2.52 *Bite Mark* — A stop mark on rolled products.

2.2.53 *Die Mark* — A stop mark on extruded or drawn products.

2.2.54 *Kink* — A localised deviation from an intended plane.

2.2.55 *Fin* — A thin flange of excess metal squeezed out between the rolls in the production of hot rolled rod.

2.2.56 *Flash* — A thin flange of excess metal squeezed out between the die faces in the production of a die forging.

2.2.57 *Lug* — A thin, narrow projection from the main body of a forging.

2.2.58 *Burr* — A sharp ragged projection at an edge, generally associated with a cutting operation.

2.2.59 *Burred Edge* — A thin turned down edge on sheet, extrusion or foil resulting from shearing.

2.2.60 *Spill* (*Sliver*) — A thin elongated piece of the parent metal adhering imperfectly to the surface of a product.

2.2.61 *Mismatch* (*Offset*) — The maximum lateral displacement of any point in that part of a forging formed by one die, from its correct position relative to the part of the forging formed in the other die of the pair.

2.2.62 *Lock* — A condition in which the parting line of a forging is not all in one plane.

2.2.63 *Blister* — A raised area on the surface of the metal caused by the expansion of a gas (for example, hydrogen) enclosed in a sub-surface void.

2.2.64 *Coating Blister* — A blister in the coating of an alclad or a clad product.

2.2.65 *Adhesion or Bond Blister* — A blister associated with discontinuity in metallurgical bending between the coating and the core in clad material.

2.2.66 *Double Skin* — A thin surface layer separated from the parent material by a film of oxide or other foreign matter and originating during extrusion.

2.2.67 *Lamination* — Internal crack aligned parallel to the principal surfaces of a sheet or plate.

2.2.68 *Inclusion* — A foreign body accidentally entrapped within the metal.

2.2.69 *Shrinkage* — Contraction that occurs when metal cools from the hot working temperature.

2.2.70 *Segregation* — Localized concentration of one or more of the constituents of an alloy.

2.2.71 *Seam* — A line juncture resulting from the deliberate bonding of two or more edges by pressure, fusion or mechanical interlocking.

2.2.72 *Extrusion Defect* (*Piping*) (*Coring*) — An internal defect occurring at the back-end of an extrusion due to oxide from the surface of the cast billet being extruded into the product.

2.2.73 *Extrusion Seam* — A seam in tube, pipe and hollow shape resulting from the pressure bonding of two or more edges in the course of extrusion through a spider or port hole die.

2.2.74 *Piping* — An axial discontinuity in a round swaged bar.

2.2.75 *Critical Working* — Cold working of metal to such a degree as to give rise to very coarse grain on subsequent annealing or solution treatment.

2.2.76 *Equiaxed Grains* — Grains or crystals which have approximately the same dimensions in three axial directions.

2.2.77 *Grain Growth* — The coarsening of the crystal structure occurring under certain conditions of heating or combined heating and cold working.

2.2.78 *Grainflow* — Elongation of the crystal structure in the direction of working, revealed by etching a polished section.

2.2.79 *Multi-hole Effect* (*Crescent Effect*) — A characteristic non-concentric configuration of grain structure resulting from the use of multihole dies.

2.2.80 *Peripheral Coarse Grain* (*Pheripheral Grain Band*) — An area of recrystallized grains at the periphery of an extruded product, which has lower properties than the non-recrystallized core.

2.2.81 *Extrusion Effect* — The persistence of an essentially non-recrystallized core in the majority of alloys which have been extruded and solution treated. This results in substantially higher tensile properties in the longitudinal direction than are obtained with the same alloys when in other wrought forms.

2.2.82 *Hot Shortness* — A tendency to brittleness while hot.

2.2.83 *Internal Stress* — Non-uniform forces retained within the metal after fabrication.

2.2.84 *Residual Stress* — Such internal stress as may be left in the finished product after stress relieving operations have been carried out.

2.2.85 *Liquation* — Fusion of the lower-melting-point constituents of an alloy during hot working or thermal treatment.

2.2.86 *Over-Ageing* — Precipitation treatment at too high a temperature or for too long a period, resulting in the impairment of the tensile properties. It may sometimes be applied deliberately to improve resistance to stress corrosion.

2.2.87 *Under-Ageing* — Precipitation treatment at too low a temperature or for too short a period, resulting in failure to attain maximum tensile properties.

2.2.88 *Overheating* — Heating to a high temperature in such a way that liquation occurs to the detriment of the mechanical properties.

2.2.89 *Overstretching* — Stretching to such a degree that stretcher strain markings develop or the grainstructure of the metal is revealed.

2.2.90 *Spring Back* — The partial elastic recovery of materials after cold deformation, for example, bending.

2.2.91 *Ruling Thickness* — The dimension of a bar, forging or component across which the time of heat transfer is the longest in heat treatment operations.

2.2.92 *Belly* — A fullness in cross section of foil either at the centre or near the sides.

2.2.93 *Dished Edges* — Departure from flatness associated with edge distortion during shearing, slitting or blanking.

2.2.94 *Wavy Edges* — Departure from flatness represented by a corrugated or wave-like formation of the edges of a rolled product in which the centre area remains flat.

2.2.95 *Earing* — Wavy projections around the rim of a deep drawn articles due to variation in directional properties.

2.2.96 *Ears* — Wavy symmetrical projections formed in the course of deep drawing or spinning as a result of directional properties or anisotropy in sheet. Ears occur in groups of 4 or 8 with the peaks of the projections located at 45° and/or 0° and 90° to the rolling direction for the cold worked and annealed materials respectively. Degree of earing is the difference between average height at the peaks and valleys divided by average height at the valleys multiplied by 100 and expressed in percent.

2.2.97 *Oilcan Effect* — In sheet or strip a localized departure from flatness which behaves in a similar manner to the diaphram of an oilcan under alternating pressure.

2.2.98 *Off Gauge* — Deviation of thickness or diameter of a solid product, or wall thickness of a tubular product from the standard or specified dimensional tolerances.

2.2.99 *Grown (Middle)* — The difference in thickness between one edge and the centre of a rolled product.

2.2.100 *Under-Strength* — of a drop forging or stamping. Thinner than the design thickness when measured normal to the parting line.

2.2.101 *Over-Strength* — of a drop forging or stamping. Thicker than the design thickness when measured normal to the parting line.

2.2.102 *Lubricant Residue* — The carbonaceous residue resulting from lubricant burned on the surface of a forged part.

2.2.103 *Parting Line (Flash Line)* — The line on a stamping or pressing corresponding to the plane of contact between the dies used in the process of manufacture.

2.2.104 *Flow Lines* — Lines on the surface of pointed sheet, brought about by incomplete levelling of the point.

2.2.105 *Flow Through* — A forging defect caused when metal flows past the base of a rib resulting in rupture of the grain structure.

2.2.106 *Draft Angle* — In the design of die forgings. The angular departure from the direction in which the blow is struck of surfaces which are nominally parallel with that direction.

2.2.107 *Natural Draft Angle* — The minimum draft angle compatible with consistent freeing of the top die from the product during forging.

2.2.108 *Matching Draft Angle* — A draft angle greater than the natural draft angle necessitated on forgings unequally disposed about the parting line to provide coincident edges on that line.

2.2.109 *Suck-in* — A defect caused when one face of a forging is sucked-in to fill a projection on the opposite side.

2.2.110 *Forging Plane* — A plan view of a dummy showing the manner in which it should be positioned in the dies.

2.2.111 *Knock-Out Mark* — A small solid protrusion or circular fin on a forging, resulting from the depression of a knock-out fin under forging pressure or inflow of metal between the knock-out fin and the die.

2.2.112 *Random Lengths* — Cut pieces usually specified between wide limits of length.

2.2.113 *Equivalent Round* — The diameter of a circle whose area is equal to the cross sectional area of an extruded or drawn section.

2.2.114 *Circumscribing Circle* — A circle which will just contain the cross-section of an extrusion usually designated by the size of its diameter.

2.2.115 *Layer Wound Coil* — Wire wound layer on layer across the width of a spool, where the width of the coil is greater than the width of the material.

2.2.116 *Pancake Coil* — Narrow strip and flattened wire wound layer on layer where the width of the coil is equal to the width of the material.

2.2.117 *Forging Drawing* — A drawing showing the agreed contour of a forging and usually the details of grain flow and the position of mechanical test pieces and stating the minimum mechanical properties expected from such test pieces.

2.2.118 *Corrosion* — The deterioration of a metal by chemical or electrochemical reaction with its environment.

2.2.119 *Intergranular Corrosion* — Corrosion occurring perferentially at grain boundaries.

2.2.120 *Pitting Corrosion*—Localized corrosion resulting in small pits or craters in metal surface.

2.2.121 *Stress Corrosion Cracking* — Failure by cracking resulting from directional attack caused by the simultaneous interaction of sustained tensile stress at an exposed surface with the chemical or electrochemical effects of the surface environment.

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R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71 6 98 32
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
T.C. No. 14/1421, University P.O., Palayam TRIVANDRUM 695035	6 21 04 6 21 17

Inspection Offices (With Sale Point):	
Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010	2 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

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*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 27 68 00

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 89 65 28

‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, Bangalore 560002 22 36 71

Reprography Unit, BIS, New Delhi, India